燈 Tomoshibi Technology

About us

We are Japanese OnStage team **"Tomoshibi Technology"**. We are first-year students at Keio University and started to develop this product last summer when we are high-school students.

Our goal is to create **new methods of computing expression**. And we are developing products that **visualize things we cannot see**.

We also hold hands-on robotics events and present at conferences to let **people know about our activities**. And we have raised **over $60,000** to develop the robot on a large scale.

Experience Event | Presantation at the IPSJ | Summer Camp | Presentation Battle

Members

Jumpei Saito 𝕏:jun_robot
Maybe a leader.
Machanics, Software, Circuits.

Ryuki Tsuji 𝕏:cat_nekonekone
Circuit pro, started programming.
Likes cats and erotic circuit boards.

Tomohiko Iida 𝕏:hato9_810
Made the Robot Arm.
Likes fried rice and cabbage.

Tools

Communication

GitHub | Cosense | Discord | Drive

Design & Coading

Fusion | KiCAD | CubeIDE | Figma

Links

Github
Tomoshibi-technology

Twitter / X
@TomoshibiTech

Instagram
tomoshibitech

Performance Concept

In our performance, we visualize a virtual world that only a computer can see with the device we developed. Ultimately, we want to create a future where **computers and humans collaborate and mutually thrive as equals.**

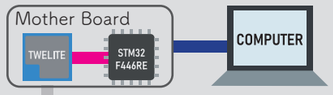
This time, a total of 12 devices (1 MovingDisplay, 3 RobotArm, and 8 LEDPole) will be used for the performance. Please take a look at **the world of computers woven** by many robots.

Design Philosophy

We are committed to **creating things ourselves** to accurately **realize the ideas in our heads**. For example, we have built all circuits such as DCDC converters and motor drivers ourselves. Knowledge can be the seed of new ideas.

Additionally, all team members have knowledge **not only in their area of expertise** but also in other disciplines. When problems arise, we can **find solutions from multiple perspectives**.

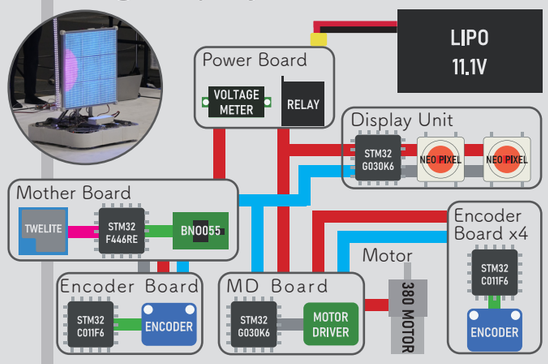
Command Center



ZigBee
RS485
UART
I2C
USB2.0
PWM
Power

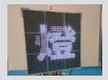
It is the command center for **controlling each device**. At the same time, it also displays images through a projector.

Moving Display



A display that can equally represent both the virtual and real worlds. It is a display that lets you **glimpse into the virtual world**.

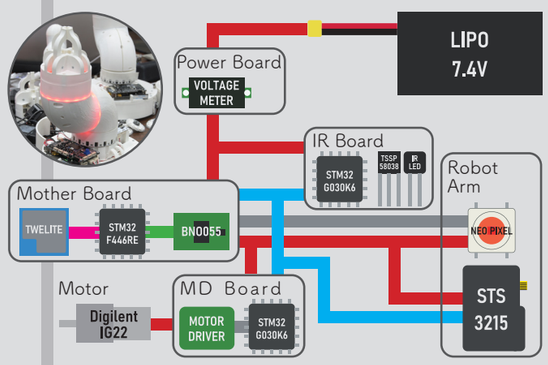
Omnidirectional Wheel
Equipped with **suspension** for stable operation.



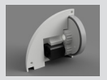
Full-color display
It displays images in the space with over 2,000 LEDs.

Self-position estimate
It measures its position using an encoder wheel.

Robot Arm

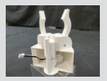


Combining movement and light, it creates expressions beyond imagination. This is a **new form of dance**.



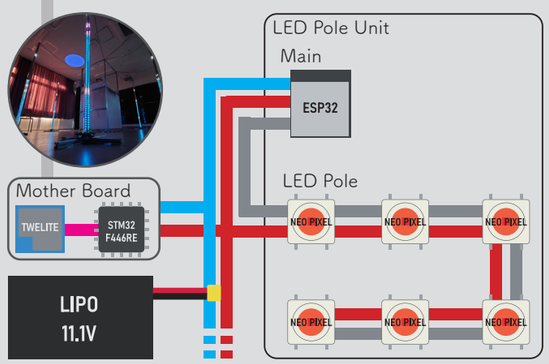
Free rotation by gears
The frame and gears were optimized using 3D printed parts.

Full Color LED
LEDs integrated into the joints, creating a beautiful expression.



Hand Mechanism
Utilized a **rack-and-pinion** mechanism and **bevel gears**.

LED Pole



Multiple full-color LEDs work together to **display a large image**. And it can also analyze ambient sounds in real-time and display them.

Control via wireless
Freely adjustable to fit **the desired space.**

Full Color LED
Each pole has 360 LEDs to visualize sound, etc.

Microphone measurements
Measure and visualize environmental sounds.

Effective Team Communication

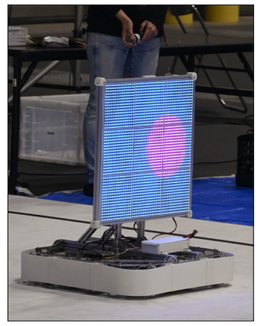
Effective team communication is essential to building a great robot. For this purpose, we mainly used **Cosense;** a document sharing tool, **GitHub;** source code version control and sharing tool, and **Discord;** contact tool.

Especially with Cosense, each member collects newly learned techniques and know-how. There are **over 500 pages of articles**, including tips on using a CNC milling machine and commands for controlling a microcontroller with the STM32HAL. Accruing knowledgh makes it easier for **other members to understand the same technology** when they want to know about it.

With Cosense, **individual knowledge becomes team knowledge**.

Features

Introducing the Amazing Features of Our Robot



1, Fixing image to Place

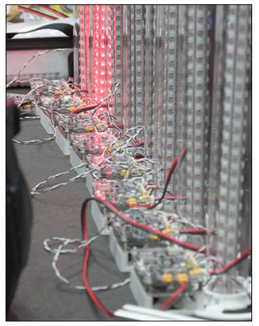
Flawless self-position estimate and correct mechanism make new XR experience.

Moving Display provides a stimulative experience for audience with **the omni-directional cart** and **full color LED matrix display** with 48x48 resolution. It performs expression like that the **image is fixed to the place** by synchronizing movement of robots with a change of the image.

For this expression, **accurate position and speed control** are absolutely essential. We made many prototypes like gyro sensor estimation. Therefore, the robot has been created with localization by spring-loaded encoder wheel, stable speed control on each driving wheel, and a suspension mechanism to avoid ground bumps.

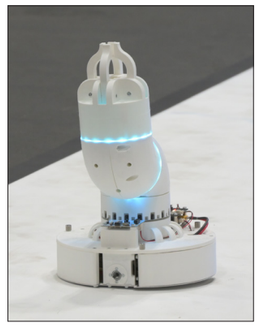
2, Real-Time Visualization

Display a large image using multiple LED Poles and Visualizing sound.



It is important that **multiple devices work together**. LEDPole has a high-speed communication line, a **5V10A DCDC converter** of our own design that can make over 300 LEDs glow very brightly, and a microphone to analyze ambient sounds.

Making the DCDC converter was challenging but essential for powering many LEDs. By designing several prototypes, we discovered that the big difference is caused by design of pattern even if they are same circuit. We made **PFM driving and nonsynchronous rectifying buck converter** because it is easier to design with low noise. We plan to develop synchronous type which is high efficiency and low noisy at low load.



3, Lighting Illusion

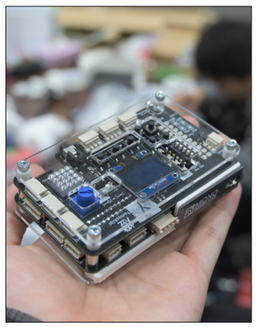
The free rotation of motor with full-color LEDs create an illusion.

RobotArm utilizes **serial servo motors and full-color LEDs** to provide viewers with a unique experience. Through the rotation of the motors and changes in the LED lights, it creates effects where points of light appear fixed or rotate at high speeds. For these effects, **free rotation of the motors** was essential. To prevent cutting the signal lines for the serial servos and full-color LEDs, we developed a **gear structure** after several prototypes.

Additionally, since serial servo motors lack a mode for free rotation with angle control, we implemented a program that allows for **speed control and position acquisition** simultaneously, thus enabling free rotation with angle control.

4, Perfect synchronization

ALL of our robots synchironize their colors and movements using RS485 and ZigBee.



Linking devices is very important to create new experiences. The 12 devices we developed have a total of **over 50 microcontrollers**. To communicate with these computers, we developed a **unique master-slave protocol** that passes over RS485 within each robot. Between each robot, we developed wireless communication using ZigBee.

Moreover, for over 50 microcontrollers, we selected pins and clock speeds optimized for the locations where they would be used. We also **designed all the boards ourselves** and unified the protocols so that all devices could work together in real time.